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Bioaccumulation and distribution pattern of heavy metals in aquaculture systems found in Arusha and Morogoro regions of Tanzania

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Abstract

The assessment of the current distribution and concentrations of As, Pb, Hg, Cd, and Cr in farmed catfish and tilapia, fish feed, and pond sediment in Tanzania is important in order to establish the potential dietary exposure to heavy metals from aquaculture sources. Thirteen fish ponds were selected from each of the 10 sites (villages) studied in Arusha and Morogoro regions. Representative samples collected were analysed using polarised energy-dispersive x-ray fluorescence (PED-XRF) spectrometer. Human health risk from fish consumption was established by calculating the estimated daily intakes (EDI), target hazard quotients (THQ), total hazard indices (HI), and carcinogenic risk (CR) of the heavy metals. Arusha had the highest concentrations (dry weight) of As (2.49–4.75 mg/kg) in the fish feed. Morogoro had the highest concentrations of Hg (1.65–2.69 mg/kg), Pb (4.59–5.64 mg/kg), and Cd (1.99–3.97 mg/kg) for sediment, fish feed, and fish muscles, respectively. Cr was the most accumulated heavy metal in the fish muscles sampled in Arusha (4.61–9.50 mg/kg) and Morogoro (2.53–5.57 mg/kg). Concentrations and EDI calculated based on mean fish consumption of 22.1 g per person per day by a 60 kg Tanzanian adult found heavy metal intakes were below the recommended daily dietary allowance (RDA) while THQ values were lower than 1, indicating no health risk related to consumption of the fish. The estimated HI was greater than 1, suggesting a potential significant non-carcinogenic health risk. The CR values were below 10⁻⁴, indicating no carcinogenic health risk in humans from fish consumption. This study recommends continued surveillance given potential bioaccumulation of these heavy metals in fish.

Keywords

Heavy metals, bioaccumulation, fish, aquaculture systems, human health risks